

# **X-56A Research Opportunities**

**Lockheed Martin visit to NASA Dryden  
August 2012**

**John Bosworth  
(661) 276-3792  
[john.bosworth@nasa.gov](mailto:john.bosworth@nasa.gov)**



**X-56A Research Opportunities, August 2012**

# X-56A Multi-Utility Technology Testbed (MUTT)

- NASA research interests
  - Develop robustness criteria for active structural control
  - Integrate emerging sensor technology (i.e. FOSS, LESP)
  - Use MDAO and flight measurements to improve aeroservoelastic modeling and analysis
  - Publish and distribute open source flight-validated realistic aeroelastic models for academia and industry use
  - Develop future research experiments (i.e. distributed conformal trailing edge flap control)



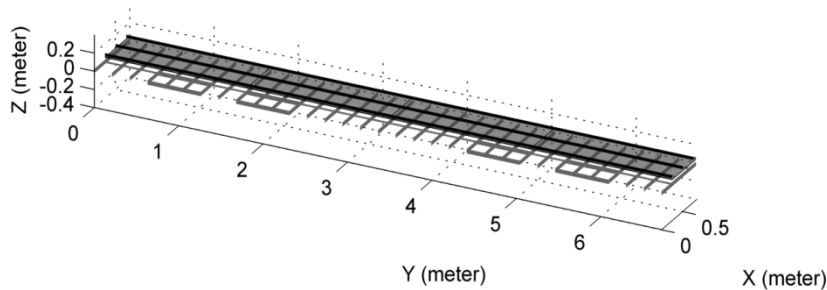
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# Aeroelastic Control using FOSS

## Generic Aluminum Wing Geometry

FOSS and Fictitious Panel Layout on FEM model

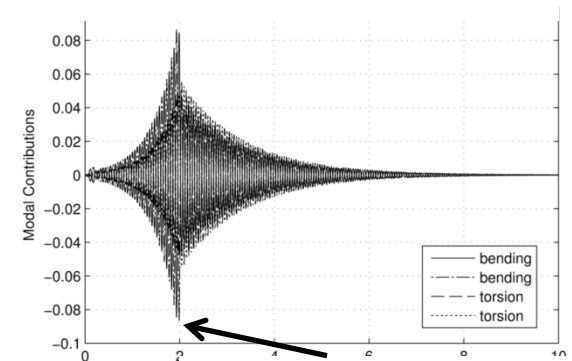
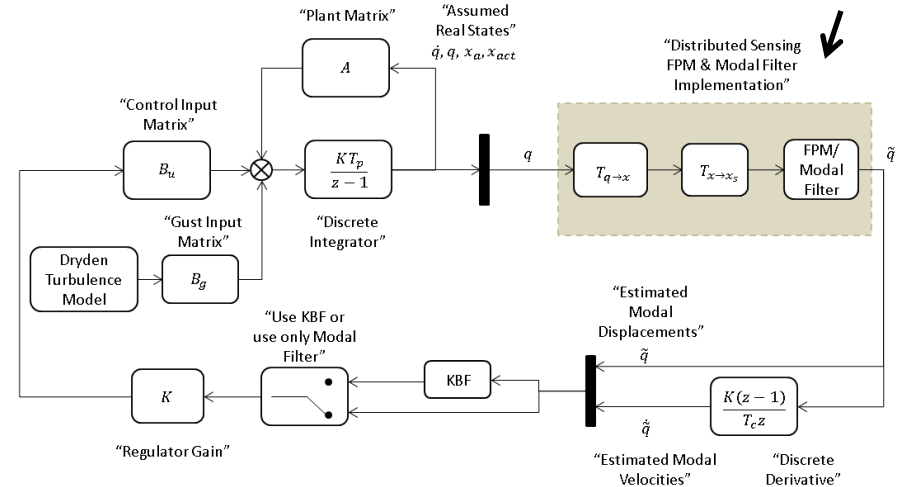
FOSS lines = 3  
Fictitious Panels = 4



- Using an analytic model simulate measurements from a Fiber Optic Strain Sensing (FOSS) system
- Investigate different control strategies to develop methods to best utilize this information for enhanced flight control

Simulation Model for FPM  
Based Modal Filtering

**Simulated  
FOSS**



**Suppression On**

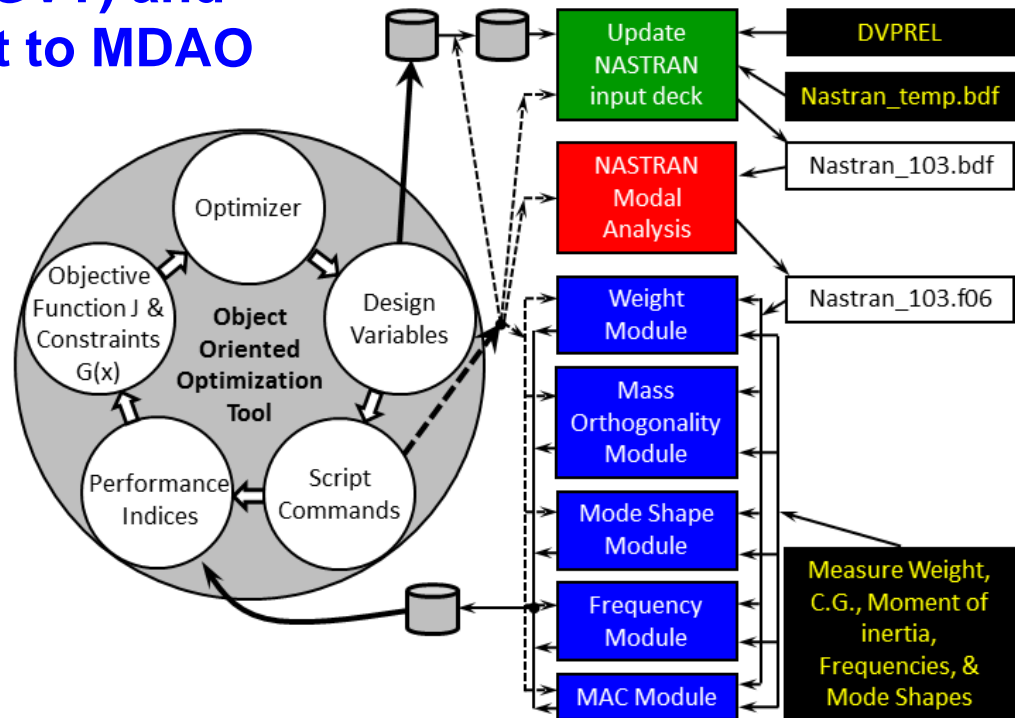


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Peter Suh (661) 276-3402 peter.m.suh@nasa.gov

# Structural Dynamic Model Tuning using Object Oriented Optimization Tool

- **Ground Vibration Test (GVT) and flight data used as input to MDAO tool**
- **Vary model parameters to match test-measured characteristics**
- **Lessons learned provide model improvement for future designs**
- **Validated models published for research community**

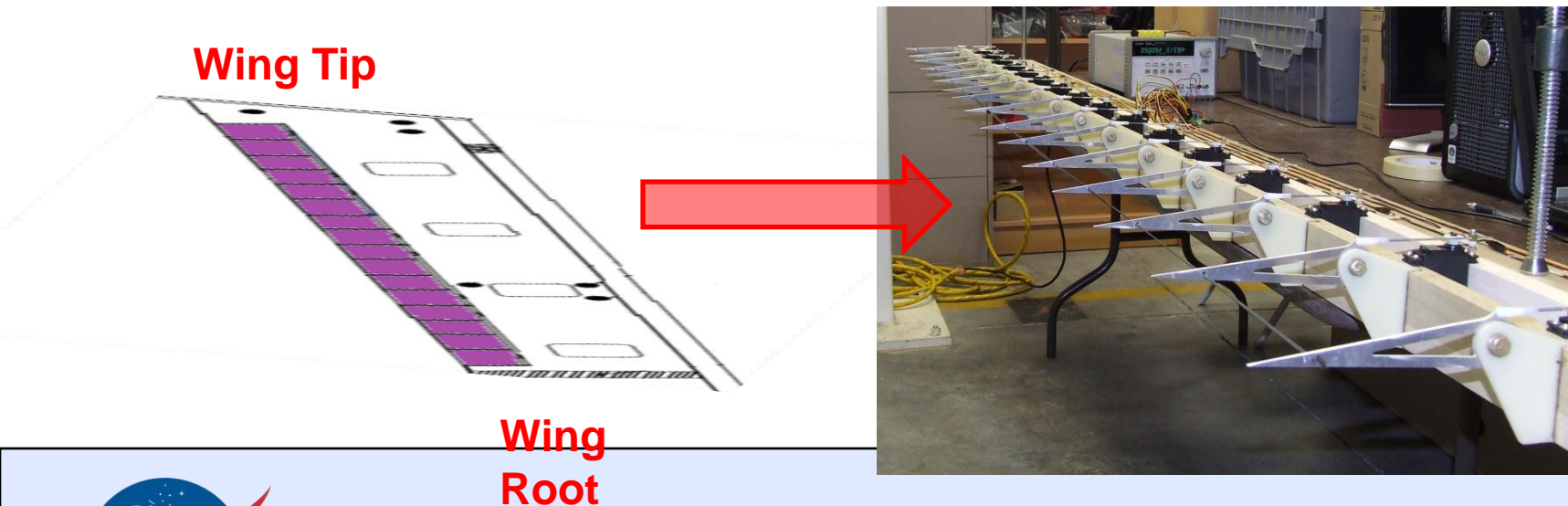


# X-56A Research Opportunities, August 2012

**Chan-Gi Pak (661) 276-5698 [chan-gi.pak-1@nasa.gov](mailto:chan-gi.pak-1@nasa.gov)**

# Distributed Conformal TEF Surface Control

- Developed bench model to demonstrate concepts
  - Model built based on X-56A control surface dimensions
  - 16 independently actuated control surface ribs
- Optimal Control Allocation (OCA) can approximately mimic the constraints imposed by a constrained smoothing spline
  - Emulate and enforce boundary and adjacent surface constraints in software



# Other Work using X-56A as Sample Case

- Active/adaptive flexible motion control with aeroservoelastic system uncertainty
  - Add control delta based on difference between model predicted and output response measurement
- Unsteady Aerodynamic model tuning using object oriented optimization tool
- CFD-based flutter analysis
  - Using a known structural model (FEM) and unsteady CFD, use an iterative process to determine the critical dynamic pressure (flutter boundary)



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Chan-Gi Pak (661) 276-5698 [chan-gi.pak-1@nasa.gov](mailto:chan-gi.pak-1@nasa.gov)



# To Fly What Others Imagine ...

